the most intense in this region; it is one of the strongest in the map of Fievez (1883), and also in all three strips of the Winchester Solar Spectrum of Piazzi Smyth (1884). Finally, Thollon (1890) draws it as the strongest in this region. It would seem, then, that further evidence is required before we can conclude that the line is really variable, for all authorities except Ångström agree in making the line a strong line.

III. The line Angström 6361·16.

In the Philosophical Transactions of the Royal Society, 1873, No. 163, Part 1, in a paper "On Spectrum-Analysis in connexion with the Spectrum of the Sun," Mr Lockyer gives a long line of zinc at w. l. 6362·5, and remarks, "This line was in the Sun in Kirchhoff's time, but has now dropped out; its number on Kirchhoff's map is 771·7." Turning to the British Association Catalogue for 1878, the observations for which were made by the late Mr. Burton, we find K 771·8 identified with w. l. 6361·41, and its origin attributed to zinc. The number 6361·41 has been obtained from the w. l. 6361·16 as given in Ångström's catalogue by applying the correction indicated at p. 29 of his memoir. Burton places the line among the faint lines of the solar spectrum, and it is also drawn as a faint line on Ångström's map. It was therefore to be seen on the Sun in 1861, 1868, and 1878. I have observed the line as widened in Sun-spots five times in 1884, and twice in 1889, and I have no evidence of my own to show that the line was not to be seen in intermediate years.

Note on the Sun-spots of 1888. By E. W. Maunder.

The sun-spots of 1888 were by no means so interesting as those of 1889, for they did not present those strong indications of reviving energy which were seen in the latter year. I have, however, thought that it might possibly be worth while to give year by year some such summary of sun-spot phenomena as I attempted in the paper I read at the April meeting of the Society; and as in this case it would be desirable to do so, not only for future years in their turn, but also for the past years of the Greenwich record, I have commenced with 1888, hoping to follow it with similar notes for the years 1882 to 1887.

Before taking the spots of 1888 I should like to make a slight addition to what I said before concerning the spots of 1889, with the view of strengthening the opinion I then expressed, that the great spot of June 16, 1889, marked the commencement of the new cycle. This may be seen most clearly by dividing the year into two portions: viz., January 1 to June 15, and June 16 to December 31. The latter portion of the year may likewise be further divided into two divisions, the first division including the spots within 10° degrees of the equator, which for the most part may be considered to represent the last efforts of

the old cycle; and the second, the spots distant 20° or more from the equator, which certainly belong to the new cycle, and are its earliest indications. The following table will show strikingly how distinct was the revival both in the mean area of the spots and in their mean distance from the equator after the first half of the year was passed:—

	Mean Daily Spotted Area.	Mean Distance from Equator of all Spots.
		°
1886	381	10·38
1887	179	8·44
1888	89	7·39
1889, Jan. 1 to June 15	18	5·03
1889, June 16 to Dec. 31	130	12·37

If we separate the spots of the last period into two divisions as suggested above, the distinctness of the zone occupied by the spots of the new cycle comes out very clearly:—

Sun-spots from 1889, *June* 16, *to December* 31.

	Mean Daily Spotted Area.	Mean Distance from Equator of all Spots.
		°
Equatorial zone	82	6·59
High latitudes	48	22·41

The increase in area and latitude shown in the equatorial zone in this latter portion of 1889, as compared with the former, was due entirely to one group—the group first seen on June 16—which in its three distinct appearances contributed more than 41 per cent. of the total spotted area of the year. From its position, since it lay in the equatorial zone, this group ought to be reckoned as belonging to the expiring cycle; from its extent and importance, and from the manner in which its appearance was followed by outbursts in the higher latitudes, it may well be reckoned as the first group of the new series.

The duration of the latter groups of 1889 was considerably greater than of the earlier, thus affording a further reason for considering June to be the turning-point. Up to June 15 the mean duration was $7\frac{1}{2}$ days; after June 15 it was 13 days. The number of spot-groups also showed an increase in the latter part of the year. Up to June 15, 10 groups were observed, or, deducting for one reappearance, 9; after June 15 there were 22 groups, or, deducting for reappearances, 17.

Associated with the duration of the groups is their total and mean daily area per group. The mean daily area of a group in 1888 averaged higher than in 1889; but, the lifetime of a group being so much shorter, the total area per group during the entire period of observation was lower in the former year.

	Mean Daily Area per Group.	Total Area per Group.
1888	210	592
1889	140	878
1889, Jan. 1 to June 15	55	294
„ June 16 to Dec. 31	171	1143

This comparison, like the former ones, shows a great increase in energy during the latter part of 1889.

Turning to the sun-spots of 1888, I have already mentioned three features which they presented, in my April paper (*Monthly Notices*, Vol. l., No. 6, p. 361). First, that several characteristics showed that the solar cycle had nearly, but not quite, run out in 1888; for, though that year was inferior to 1887 both as to the number of spot-groups and as to the mean daily area, and presented also a higher number of days without spots, yet in all these three points it had the advantage over 1889, and especially over the first half of it. Secondly, the mean latitude was lower than for 1887; and, thirdly, the average life of a spot was shorter, whilst, as has just been stated, 1889 on the whole, and especially in its latter half, was superior in these points to 1888. The place, therefore, of 1888 in the cycle is very clearly defined. It came almost at the very end, but the actual termination of the old cycle and the beginning of the new one was reserved for 1889. One indication, and one indication alone, was afforded of the coming revival. A very small spot was seen on one day only, in a latitude far outside the zone proper to a period of decline. On December 30 a spot of area 7 was seen in Lat. $-35°\cdot5$, 20° further from the equator than any other spot of the year.

Localities of Formation and Dissolution.

Out of the fifty-four separate groups of the year, there were only two cases of reappearance in a second rotation, and in only one of these cases was the group seen a third time. In both instances the formation and dissolution took place in the visible hemisphere. There were thus fifty-one separate groups in 1888. It should be added, however, that two groups had been seen in earlier rotations which fell in 1887. Thus group 2029 of January 1888 had been seen a month earlier in December 1887, and group 2026 was the third appearance of the group which had been seen in 1887 as groups 2017 and 2021.

Of the fifty-one separate groups of the year, thirty formed and dissolved in the visible hemisphere and were seen nly in one rotation, ten of these being seen only on one day. Two formed and dissolved in the visible hemisphere, but were seen in more than one rotation; five formed on this side of the Sun, but were dissipated on the other; eight formed on the other side, but were dissipated on this, one of the eight being seen during more than one rotation: and six of which five were seen only in one

rotation, but the sixth in three, formed and dissolved in the unseen hemisphere. The following table shows how 1888 compares with 1889 in this respect:—

	1888.	1889.
Unseen hemisphere—formations	14	3
„ dissolutions	11	4
Visible hemisphere—formations	37	23
„ dissolutions	40	22

Disregarding spots seen only in the visible hemisphere:—

	1888.	1889.
Visible hemisphere—formations	6	5
„ dissolutions	10	4

The unseen hemisphere, therefore, was decidedly the more prolific of spots of sufficient duration to belong to both hemispheres, whereas in 1889 the balance was the other way.

A very striking difference between 1888 and 1889 is seen when the spotted area of each lune of 13°·2 is taken:—

Lune or Day.	Formations.	Dissolutions.	Ephemeral Spots.	Total Area.
First	0	1	0	1943
Second	5	1	1	2736
Third	3	4	1	3718
Fourth	4	3	2	3728
Fifth	2	2	0	3202
Sixth	3	2	2	2806
Seventh	4	3	0	2663
Eighth	1	3	0	2470
Ninth	1	0	0	2148
Tenth	2	2	4	2333
Eleventh	1	4	0	2291
Twelfth	0	5	0	1837
Thirteenth	1	0	0	862

It will be remarked that, whilst in 1889 there was a steady increase in the spotted area from the east limb of the Sun to the western, in 1888 the case was almost reversed. The maximum area was attained at the third and fourth days, and there was a rapid and fairly regular decline afterwards. The formations, as in 1889, were much more numerous to the east of the central meridian, but, including the "ephemeral" spots, or spots seen only on one day, the dissolutions also were slightly more numerous in the eastern quadrant, whereas in 1889 they had been most frequent in the western.

Distribution in Longitude.

1888 did not afford such an extreme example of concentration of energy in one district as was afforded by the great group of June 16, 1889, but the spotted area was by no means evenly distributed. The most prolific district was that, the centre of which lay in Long. 275° and Lat. −7°. On four distinct occasions a considerable outbreak occupied this region, but in no case did the group return a second time. Group 2052 was the largest group of the year; group 2066, the third in size: but the latter group appeared four rotations later than the former. That the disturbed district was the same was, however, shown by two shortlived and much smaller formations, which were seen in the intermediate rotations. This district embraced 28·4 per cent. of the entire spot-area of the year.

Three other localities contributed about 11 per cent. apiece. Of these one, and the most interesting, had its centre at Long. 298° and Lat. −5°; seven groups, one of them the most permanent of the year, appearing in this district. Throughout 80° of the Sun's circumference the only spots observed lay in one or other of these two districts—*i.e.*, either close to Long. 275°, or close to Long. 298°. Another had its centre in Long. 163°, Lat. −12° Four groups were seen here, two of them large, with an interval of three rotations between the two outbursts. The stability of the centre of disturbance in these three districts, of which I have given the positions, is very remarkable when contrasted with the intermittent character of the actual spot-formations, and the same thing was seen on a minor scale in several other regions. The three districts together comprised more than half the spotted area of the year, and formed the locale of fifteen out of the fifty-one separate groups; yet only in one case was an outbreak sufficiently vigorous to last out a complete rotation.

Note on the Spot-group of 1890 *August* 25–*September* 5.
By E. W. Maunder.

A fine group of sun-spots appeared on the east limb of the Sun on August 25 last. This was the second appearance of the group, which had been observed during the preceding rotation, and it was also seen again during the rotation following, its formation and dissolution taking place in the invisible hemisphere. It was at its second appearance that it attained its greatest size and beauty of detail, and it was at this time that it afforded a threefold example of an apparent rotation round each other of pairs of nuclei, which seemed to me sufficiently well marked to justify a record.

As the group drew away from the east limb it first showed itself, on August 26, as composed of three principal spots. The